First Quarter, 1997

Visitors

In Quarter 1, 1997, the facility hosted 869 visitors which, when added to the 1996 total of 319 brings the total for the project to 1,188 documented visitors. In Quarter 1, 1997, groups came many foreign countries including England, China, Brazil, Japan, India, New Zealand, the Czech Republic, Egypt, France, and Korea. Other groups represented U.S. firms interested in the technology, U.S. engineering societies and community groups.

Operations:

Four gasifier runs totaling 1250 hours were completed in Quarter 1, 1997. Run 22 was a continuation of a run that began December 24, 1996 and ended on January 22, 1997 and accounted for 508 of the Quarter 1, 1997 hours. Including the hours that were reported for 1996, run 22 achieved over 694 hours of gasifier run time making this the longest run achieved to date. The run was interrupted to repair a leak in the black water blowdown to vacuum flash drum piping. Table 1 below details three other runs that were achieved during the quarter and lists the reason for the termination of each run.

Run 25 began on March 14, 1997 and was terminated on March 16, 1997 due to a leak in the Steinmuller raw gas/clean gas heat exchanger. The result was significant damage to the combustion turbine due to ash particles melting and agglomerating on the first stage nozzles and on the first stage blades of the combustion turbine. The repairs to the Steinmuller raw gas / clean gas heat exchanger and to the combustion turbine continued into April, 1997. Details of the repairs to the gas to gas heat exchanger and to the combustion turbine are described below in the sections of this report which cover high temperature cooling and the combined cycle.

TABLE 1
Gasifier Runs, Shutdown Causes
Quarter 1, 1997 Operation (January, February and March, 1997)

Run Number	Duration (Hours)	Turbine On Syngas (Hours)	Shutdown Cause
22	507.80	495.80	Run 22 began in December, 1996. The hours shown here are for 1997 only. The run was ended due to a leak in the RSC sump black water blow down to vacuum flash drum piping.
23	412.62	388.95	Excessive grey water ash build up.
24	280.37	258.30	"A" syngas scrubber nozzle mounting flange leak.
25	48.73	18.27	Steinmuller dirty gas / clean gas heat exchanger tube failure.
Total	**1,249.52**	**1161.32**	

Specific operational experiences are detailed in the remainder of the report.

AIR SEPARATION

The ASU continues to operate very well meeting all of the purity and flow requirements.

On March 4, 1997, during a plant shutdown, liquid oxygen carried over into the oxygen compressor suction line from the LP distillation column due to a solenoid failure and a maintenance switch being operated. The carbon steel suction line became brittle due to the low temperatures created by the vaporization of the liquid oxygen in the piping causing the line to fracture. The line was repaired by replacing the affected piping. Controls were enhanced to minimize this type of incident in the future.

Performance testing of the ASU is scheduled for May, 1997.

SLURRY PREPARATION

The slurry system has consistently produced the amount and quality of slurry required. Difficulties have been mainly due to plugging of the vibrating screens, short life and high rebuild costs of the mill discharge and run tank transfer slurry pumps and failure of mill pinion bearings due to overheating. The pinion bearing problem was solved by interchanging the fixed and floating bearings on the pinion so that the pinion shaft can expand freely away from the driver. Vibrating screens with larger spacing are on order and are expected to reduce plugging. The project is addressing the slurry pump short life issue by experimenting with natural rubber replacement liners in place of the original latex rubber liners and with full size rotors (minimum radial clearance) in place of the original rotors which were undersized to provide running clearance on the mill discharge pumps.

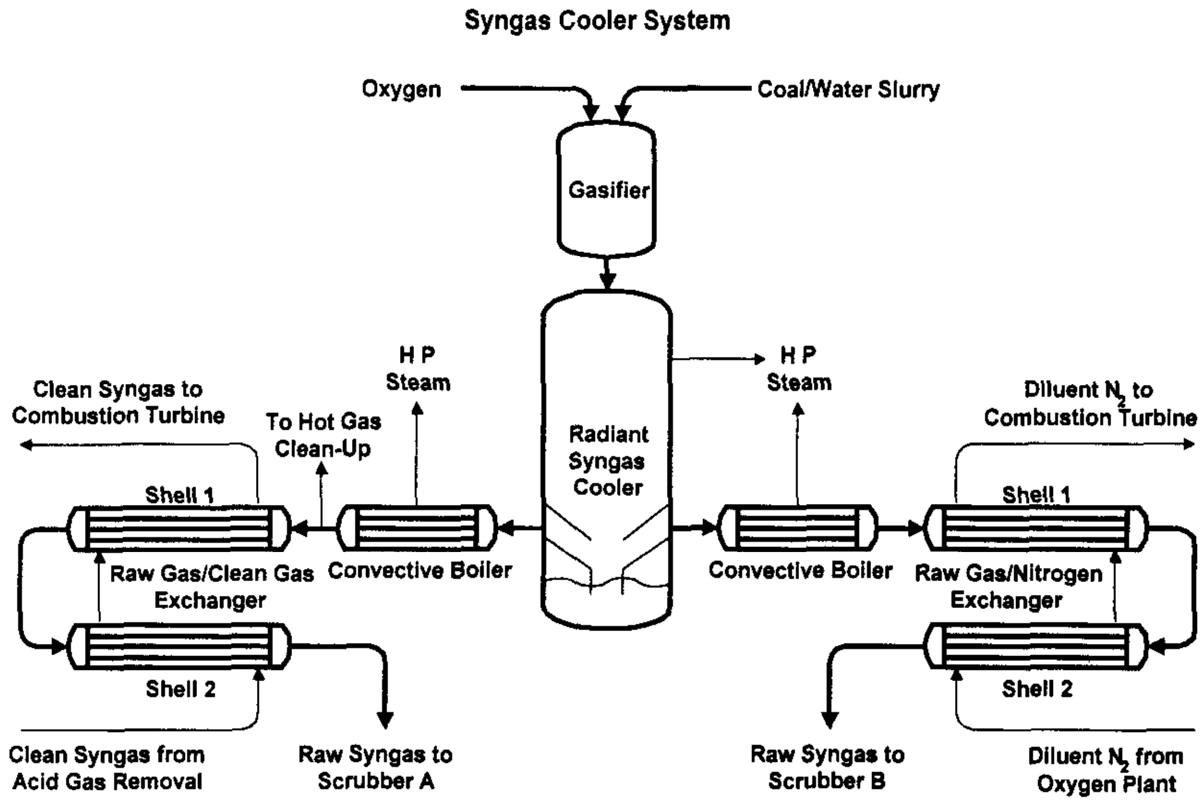
GASIFIER

Measurements following Run 25 in late March indicated the remaining life on the gasifier's startup refractory liner was between 45 and 90 operating days. Since the outage was of long duration, and it was undesirable to risk having to replace the liner in peak season, the startup liner was replaced. The startup liner provided 2344 hours of operating service with perhaps 1000 to 1500 hours of service remaining. This was as expected for the lower quality startup liner. The new liner is higher quality and is expected to provide a two year life.

Minor modifications to the process feed injector have been made in an attempt to improve carbon conversion, but the data showed no significant change. Carbon conversion remains in the 95.5 to 96.5% range, depending on operating conditions. The lower carbon conversion results in higher fines production which places a higher duty on the carbon scrubbers, the gravity settler, and the fines filters. The carbon scrubbers are able to handle the increased duty under most conditions with some difficulty. Modifications will be required to the fines handling system. Also, work is ongoing to find ways to recycle the fines back to the slurry preparation system so that the heating value of the fines can be recovered to improve plant heat rate.

The gasifier continues to produce twice the expected amount of Carbonyl Sulfide (COS) from Pittsburgh #8 coal. This increases sulfur emissions from the facility as discussed in the Acid Gas Removal section of this report. There are no likely hardware or operational modifications to the gasifier which are likely to reduce COS production, but changing coals could help.

HIGH TEMPERATURE SYNGAS COOLING



The Radiant Syngas Cooler and Convective Boilers continued to perform very well during the quarter. Fouling factors are less than half of design levels.

A serious failure of the second stage raw gas / clean gas heat exchanger occurred during Run 25 between March 14 to March 16. The higher pressure, ash laden raw syngas leaked through a ruptured tube into the lower pressure clean syngas en route to the combustion turbine. The ash melted in the turbine's combustor and deposited on various turbine components (see the Power Block Section). The tube failure was determined to have been caused by stress corrosion cracking, most likely initiated by earlier ash plugging problems in these exchangers. The following repairs were made to try to avert similar incidents in the future:

1) The second stage of the Raw Gas/Clean Gas Exchanger was removed from service. Eddy current testing had shown the tubes in this shell to be in the worst condition of the four gas to gas exchanger shells.

2) All tubes with corrosion pit depths to greater than 40% of the tube wall thickness were either replaced or plugged. This involved 31 tubes.

3) Bypass valves were added so that clean gas could be bypassed around the gas to gas heat exchangers to avoid another long outage in the event of a future heat exchanger tube leak.

4) Improved leak detection procedures were implemented to ensure that any future leaks will be detected at low levels. With this information, steps can be taken to transfer the combustion turbine off syngas fuel before damage to the combustion turbine occurs.

LOW TEMPERATURE GAS COOLING (LTGC)

The heat exchangers, knockout drums, and process condensate systems performed well during the quarter.

The ammonia stripper column contains an upper packed section which performs cooling and condensation. The original packing material was incompatible with the packing supports and most of the rest of the column internals. The resulting corrosion caused the failure of many of the components in the upper section of the column. For example, the packing support had completely dissolved. New packing of a more suitable material was procured. Due to long lead time on some column internals, replacement packing supports and distributors were designed on-site and fabricated from readily available materials, and the other damaged components were repaired. The column was then successfully returned to service.

ACID GAS REMOVAL

During the first quarter the AGR unit had poor performances due to high heat stable amine salts (HSAS), rise in MDEA temperature due to increase in ambient temperatures, and amine dilution/concentration swings. We were only able to meet present emissions limits on the lower sulfur fuel coals. COS is our major sulfur contributor in the treated syngas stream to the turbine from the AGR unit. H_2S is our only controllable syngas sulfur contributor while using the AGR unit. The present slurry uses low sulfur fuel to reduce the COS/H_2S production, thereby allowing the AGR unit to maintain present emissions requirements.

To reduce HSAS the amine was reclaimed using an on-site electrodialysis technique. The reclaiming was successful. HSAS were reduced from 6.4 weight % to .8 weight %.

The MDEA concentration swings were eliminated with the implementation of a new control algorithm. The new controls continually monitor net water vapor losses from the system and make up accordingly with steam turbine condensate.

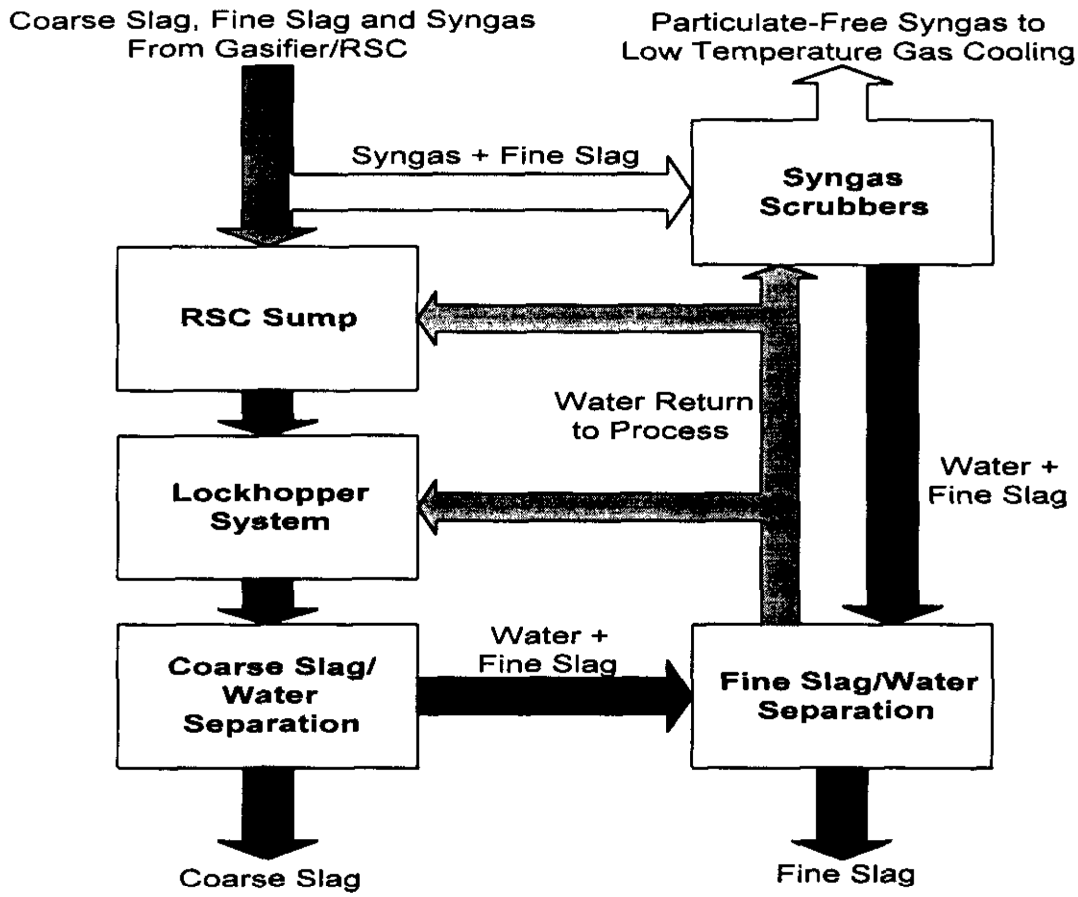
Dual acid gas absorber tray feed locations were used to successfully reduce absorber temperature. Also, good absorption was maintained with the dual feed configuration.

SULFURIC ACID PLANT

The sulfuric acid plant continues to perform well once steady, efficient operation is established. The Pittsburgh #8 coal continues to have a sulfur content of less than 2.5% which requires supplemental fuel to maintain temperatures in the catalytic reactors.

SLAG HANDLING, FINES REMOVAL, AND PROCESS WATER SYSTEMS

Process Water, Coarse and Fine Slag Handling



The slag handling system continues to be labor intensive. Run 23 was terminated due to overwhelming fines problems and the fines removal system is marginal under all operating conditions. Data is being gathered to support various redesign concepts in these areas.

Runs 22 and 24 were terminated due to leaks resulting from localized erosion in black and grey water piping, respectively. As such problems are identified, the local piping is redesigned, and these specific areas are added to the already extensive UT surveillance program.

BRINE

During the beginning of the first quarter the brine unit had poor performance. Foaming and carry over from the grey water evaporator vapor separator entered into the blowers and caused pitting, erosion and Chloride attack to the blowers and piping. A defoamer metering pump station and drain boot from grey water evaporator vapor separator drum were installed.

Centrifuge clogging occurred frequently. We are assessing the possible use of a vibrator or air cannon on the centrifuge chute that will clear the chute every 30 seconds automatically.

The forced circulation evaporator, crystallizer flash drum, evaporator vapor blowers and crystallizer centrifuge received extensive attention during the first quarter due to corrosion, wear, and pluggage issues. The blowers have become quite corroded and are going to be blocked out, if necessary. Low pressure steam to the blower discharge will then be used to produce the brine in the grey water evaporator. Forced circulation (FC) evaporator condenser has had massive corrosion. The corrosion is due to mist carry over into the FC condenser. A change in the FC condenser metallurgy has been decided to help to alleviate this issue. The present condenser will be replaced, tentatively within the third quarter, with a new condenser made of titanium Gr2. The unit has run during the first quarter and the above issues are currently being addressed.

COMBINED CYCLE

The power block as a whole performed well during run #22 and #23. However, of concern was the exhaust temperature spreads that continued to ramp up during these extended runs.

In mid February at the end of run #23 the power block was made unavailable to install a new nitrogen injection control valve with a higher C_v so that enough diluent nitrogen could be delivered to the combustion turbine to meet NOx emissions limits at full load. During this outage the CT end covers were also inspected. The end cover inspection revealed that deposits were forming unevenly on the fuel nozzle ports, skewing the syngas fuel balance, resulting in the experienced CT exhaust temperature spreads. The deposit material was determined to be predominantly nickel sulfide. The deposit was removed and spreads returned to normal.

During run #24 the power block ran predominantly at reduced loads due to problems with the rod mills. At the end of run #24 both mills were returned to service and full load (192 MW) was achieved on the combustion turbine.

Extensive fouling of the combustion turbine first stage nozzles and blades resulted from the tube failure in the raw gas / clean gas heat exchanger that happened during run 25 which went from March 14 to March 16, 1997. The combustion turbine required disassembly and replacement of the following components: combustion liners and transition pieces, first stage nozzles, first stage buckets, and second stage nozzles. The components which were removed are scheduled to be refurbished and returned to the spare parts inventory.

The CT fuel valves continue to be a source of delays during startup and have caused turbine trips during syngas and distillate fuel transfers.

CONTROL SYSTEM

The distributed control system (DCS), the PI data historian, the emergency shutdown system (ESD) and the GE turbine controls were 100% available during Quarter 1, 1997. Over extended controller modules were replaced with higher capacity modules. Automatic Generation Control (AGC) logic was incorporated and improved but not tested. The advanced controls for the air separation unit were further tuned. New instrument air system logic was implemented and tested. An enhanced sequence of events recorder for the ESD was installed and tested. Acid plant decomposition furnace combustion control was enhanced to include AGR fuel gas analysis as trim. Acid plant "first-out" logic and graphics were added and tested. Brine controls are continually being changed as process modifications are made.

The ESD had no hardware failures. The DCS infant mortality problem reported in 1996 has diminished significantly. Although some non-critical I/O modules failed, the failure rate is lower. All failed modules were replaced under warranty.

The alarm optimization project aimed at adding smart alarm features and reducing nuisance alarms continues through quarter I. It is anticipated this effort will continue into 1998.

Graphic display optimization continues as operators and engineers suggest changes, corrections and enhancements.

Data link additions and corrections continue to be performed on the combustion turbine, the steam turbine and the ESD datalinks.

HOT GAS CLEAN UP

During the first quarter the attrition test for the hot gas clean up system sorbent was aborted due to both mechanical and controls/tuning problems that prevented operation of the automatic sorbent transfer sequence. TECO will make arrangements with GEESI to hire a consultant to assist in troubleshooting the problems found during this aborted test. The major problems encountered were:

1) Nitrogen purge valves on two of the absorber lockhoppers did not seat properly; therefore, the vessels could not be vented to the minimum pressure necessary for sorbent transfer from one vessel to the other.

2) The skip hoist load cell was reading incorrectly, causing it to overfill on the second load in the sequence. The load cell will have to be calibrated by loading a known amount of sorbent into the lockhopper.

3) Several of the nuclear switches were toggling from full to empty while sorbent was being transferred between vessels, thus interrupting the sequence.